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# BGSU's Guide to Laboratory Safety & Health

Environmental Health & Safety  
1851 N. Research Drive  
372-2171



Last revised October 2016



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## **To the Student**

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This guide has been developed to assist with the training of laboratory employees. Safe and healthful work practices required in University laboratories are described.

You are responsible for following all requirements of the University's Laboratory Safety/Chemical Hygiene Plan. The requirements are

- Following safety procedures.
- Reporting any unsafe condition, accident, or injury to the person responsible for the laboratory (the Principal Investigator).

The Laboratory Safety/Chemical Hygiene Plan has been established by Bowling Green State University to comply with Ohio's Public Employment Risk Reduction Act, and standards of the Occupational Safety and Health Administration.

This guide is for the sole use of Bowling Green State University.

## Ohio's Public Employee Risk Reduction Program



### Ohio Public Employment Risk Reduction Program

## Safety and Health Protection on the Job It's The Law!

The Public Employment Risk Reduction Act ensures safe and healthy working conditions for Ohio's public employees.

**Public employers** shall provide a place of employment free from recognized hazards and be in compliance with the Public Employment Risk Reduction Program (PERRP) occupational safety and health standards, rules and regulations.

**Public employees** shall comply with the PERRP occupational safety and health standards, rules and regulations.

#### Complaints

- Any public employee or employee representative has the right to file a complaint with PERRP via fax or letter that describes unsafe or unhealthy conditions in his/her workplace. Names of public employees filing complaints will be kept confidential.

#### Refusal to Work

- A public employee acting in good faith has the right to refuse to work under conditions he or she reasonably believes present an imminent danger of death or serious harm. This applies if the condition does not normally exist or is not reasonably expected to occur during the course of the employee's regular duties. A public employee who refuses to work under such conditions **must** follow these steps.
  - Notify his or her immediate supervisor that the condition poses imminent danger.
  - Submit a written statement of the imminent danger to PERRP as soon as practical.

There is, however, no right under the PERRP Act for an employee to refuse to work, unless the danger is one that a reasonable person under the circumstances would conclude an imminent danger exists.

#### Enforcement

- PERRP investigates job sites for unsafe and unhealthy conditions and practices at the request of a public employee, public employee representative or public employer.
- It issues citations requiring public employers to correct safety and health violations.
- A PERRP investigator may privately question a representative sample of employees and management about safety and health conditions in the workplace.

#### Citations

- If the investigation verifies a violation, PERRP will issue a citation. The public employer must then prominently post this citation in a conspicuous place where they customarily post such notices to their employees.

#### Reporting Fatalities/Multiple Hospitalizations

- A public employer must contact PERRP *within eight hours* of:
  - Death of any employee from a work-related incident;
  - Inpatient hospitalization of three or more employees from a single work-related incident.

#### Access to Records

- Employees have the right to copies of their medical records, and records of their exposures to toxic and harmful substances or conditions.

#### Discrimination

- Employers cannot discharge or otherwise discriminate against employees in any manner for filing a complaint or instituting any provision of the Act. Employees or their representatives may file discrimination complaints with the State Personnel Board of Review within 60 days of the discriminatory act.

#### Recordkeeping

- Public employers are required to maintain a PERRP 300P Log of injuries and illnesses.
- Public employers are required to submit a PERRP 300AP Summary of Work-Related Injuries and Illnesses to PERRP by Feb. 1 for the previous calendar year.
- Public employers must keep separate records for each establishment. On Feb. 1 of each year, the employer must post the PERRP 300AP at each establishment through April 30.

#### For More Information Contact:

**Public Employment Risk Reduction Program (PERRP)**  
13430 Yarmouth Drive  
Pickerington, Ohio 43147  
Phone: 800-671-6858

Hearing Impaired: TTY/TDD 1-800-750-0750  
Fax: 614-621-5754  
[www.bwc.ohio.gov](http://www.bwc.ohio.gov)

Under provisions of Rule 4167-4-01 of the Ohio Administrative Code, public employers must post this notice (or facsimile) in a conspicuous place where they customarily post such notices to their employees. Minimum reproduction size of this poster is 8 1/2 x 14 inches. Alternatively, employers can give a copy of this notice to each employee at the time of hiring and at least annually thereafter.

## Bowling Green State University Emergency Procedure Poster

### ***BOWLING GREEN STATE UNIVERSITY EMERGENCY PROCEDURES***

#### **FIRE**

1. Close door behind you to contain fire.
2. Sound alarm by using fire alarm pull station.
3. Immediately and calmly evacuate building. Do not use elevator – use stairwell only.
4. **CALL 911** – Give location and description.
5. Do not re-enter the building for any reason. Only emergency personnel can authorize re-entry.

Note: Use portable fire extinguishers only if you have been trained and it is safe to do so. Use on very small fires only. Safe evacuation is your main priority.

#### **MEDICAL - SEVERE ILLNESS OR INJURY**

1. Check the scene. Do not place yourself in a life-threatening situation.
2. **CALL 911** – Give location and description of incident.
3. If you are trained in CPR and/or first aid, assess the need for support.

#### **CRIMES IN PROGRESS OR SUSPICIOUS PERSONS**

**CALL 911** and give information on the person and situation.

#### **SUSPICIOUS OBJECT OR PACKAGE**

1. Do not touch or disturb the object or package.
2. If there is a written threat or suspicious substance, leave object and vacate room. Wash hands.
3. **CALL 911** and follow Dispatcher's instructions. Wait for emergency officials.

#### **BOMB THREAT**

1. Get as much information as possible from the caller (location, when it was placed, etc.)
2. **CALL 911** and follow Dispatcher's instructions.

#### **TORNADO**

1. Monitor local weather stations with radio, weather radio, or TV.
2. Know your shelter locations, listed on tornado information posters in building.
3. Seek shelter when tornado warning siren or other warning systems advise.
4. Take battery-powered radio to shelter to monitor weather conditions.

#### **HAZARDOUS MATERIALS INCIDENT - CHEMICAL OR RADIATION SPILLS, LEAKS**

1. Evacuate to a safe distance.
2. **CALL 911** – Give location and description of material.
3. Prevent access to area until response team arrives.
4. If chemical or radiation material contacts eyes or skin, flush immediately and continuously for at least 15 minutes. Use eye wash station, safety shower or other water source.

#### **UTILITY EMERGENCIES - GAS LEAK, FLOODING, ELEVATOR OR POWER FAILURE.**

**CALL 372-7647**, M-F 8:00A.M. - 5:00 P.M., After these hours, call Public Safety at 372-2346.

## Bowling Green State University Building Evacuation Plans

The evacuation plans are specific for each building on campus. It includes marked locations of exits in case of a fire, and direction to the shelter-in-place locations in case of a tornado.

# EVACUATION PLAN

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## CALL 911 FIRE/POLICE/MEDICAL

IN CASE OF EMERGENCY, PULL FIRE ALARM, USE EXIT STAIRS, DO NOT USE ELEVATOR.

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## PERSONS WITH DISABILITIES

SHALL CALL 911, REPORT THEIR LOCATION, PROCEED TO THE NEAREST EXIT STAIRWELL AND AWAIT ASSISTANCE.

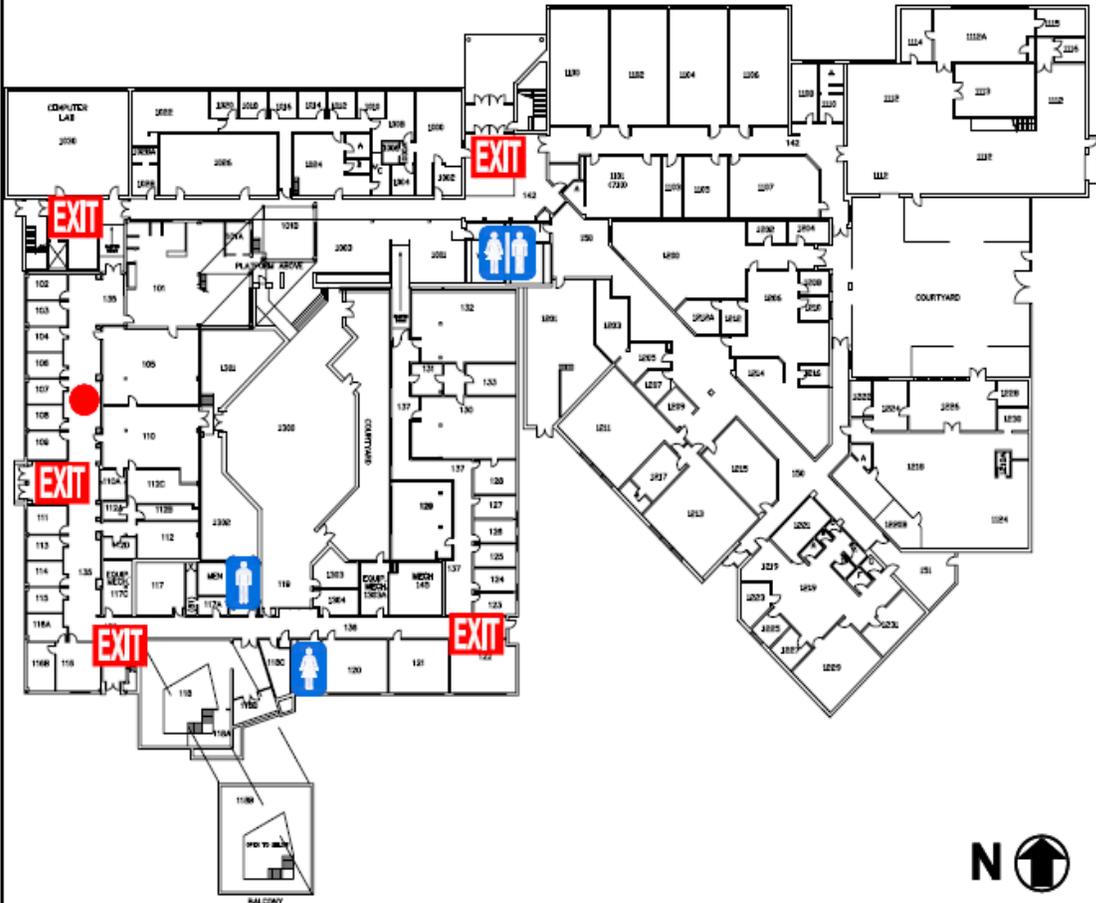
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## TORNADO

GO TO INTERIOR ROOMS, RESTROOMS, OR HALLS ON THE LOWEST FLOOR. AVOID HALLS THAT OPEN TO THE OUTSIDE IN ANY DIRECTION. STAY AWAY FROM WINDOWS.

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### FINE ARTS BUILDING - FIRST FLOOR

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**YOU ARE HERE**

 **EXIT**

4

## Emergency Rinsing Stations

### Eyewash Units

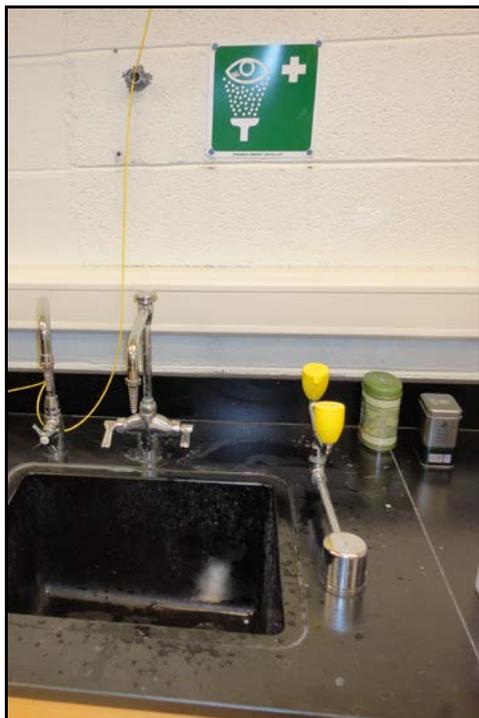
Emergency eyewash units (Figure 1) are to be used when harmful or corrosive substances enter the eyes. These units are either located on faucets of laboratory sinks, as stand alone units, or as combination eyewash/shower units. When you receive your laboratory teaching assignment, locate these eye washes and become familiar with how they operate.



Figure 1: Eye wash fountain

If someone in the laboratory gets a chemical in their eye, follow this procedure:

- Get the person to the eye wash immediately.
- Wash the eyes with a large amount of running water. You may have to help the person by pulling their eyelids back so the water can contact the eye.
- Continue washing the eye for 15 minutes.
- Have a person in the laboratory call 911 for emergency medical attention.



Examples of different types of emergency eyewash stations.

### Shower Units

Showers (Figure 2) are to be used when a chemical has been spilled extensively on the body.

If someone in the laboratory gets a chemical on their body, follow this procedure:

- Get the person to the shower immediately and pull the large release handle.
- While the shower is running, you may need to help the individual remove affected clothing. Do this as quickly as possible to reduce the contact time of the chemical on the skin.
- Continue washing the affected area for at least 15 minutes.
- Have a person in the laboratory call 911 for emergency medical attention.



Figure 2: Shower

### Combination Eyewash and Shower Units

Combination units (Figure 3) have both an eyewash and shower so they can be used together.

If an individual has a chemical in their eyes and on their body, follow this procedure:

- Get the person to this unit immediately and activate both units.
- While the shower and eye wash are running help the individual remove affected clothing and have someone else hold their eyes open.
- Continue washing the eyes and skin for at least 15 minutes.
- Have a person in the laboratory call 911 for emergency medical attention.

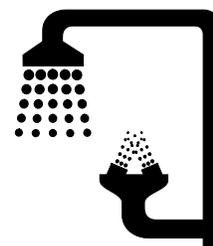


Figure 3: Combination Unit



Examples of combination emergency eyewash/shower units.

### **Drench Hose Stations**

Drenching Hoses are available in some laboratories. These are to be used when a chemical has been spilled on the body.

If someone in the laboratory gets a chemical on their body, follow this procedure:

- Get the person to the drenching hose immediately and squeeze the handle.
- While the hose is running, help the individual remove affected clothing. Do this as quickly as possible to reduce the contact time of the chemical on the skin.
- Continue washing the affected area for at least 15 minutes.
- Have a person in the laboratory call 911 for emergency medical attention.



Examples of drench hose stations.

## **Bowling Green State University Injury and Illness Reports**

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When an accident occurs in the laboratory, it often results in an injury and sometimes an illness. These must be reported if they occur. Below are frequently asked questions about the Bowling Green State University Injury and Illness Report form.

1. Why must the form be completed?

*The form must be completed for compliance with a standard from the Occupational Safety and Health Administration. Completed forms also assist Environmental Health and Safety to keep up to date on hazards on campus. This information is used to help abate them.*

2. When does the form need to be completed?

*The first page of the report must be completed and submitted within 24 hours of the occurrence of an accident. The second page of the report must be completed and submitted within 5 calendar days of the occurrence of the accident if the person injured or ill is a University employee. The accident may or may not result in an injury. Both forms must be completed in either case.*

3. Who completes the form?

*The person who was injured or taken ill, a supervisor, or a witness can complete the form as long as it is a person who has precise knowledge of how the accident occurred. The information reported in Parts 1 and 2 must be of the person who was injured or taken ill. Witness information is reported in Part 4.*

4. Where do I get a form to complete?

*The department office should have copies for you to use. Forms are also available online at: <http://www.bgsu.edu/downloads/finance/file14224.pdf>*

5. Who do I call if I have questions about the form?

*Contact the Environmental Health and Safety office at 372-2171.*

6. Where does the form get sent to?

*Environmental Health and Safety  
1851 N. Research Drive  
or fax to 419-372-2194*

## Bowling Green State University Injury and Illness Report

Instructions: This report must be submitted for any injury or illness within 24 hours of occurrence. Please **PRINT** or **TYPE** all information.

**Call 911 for serious injuries or emergencies.**

Submit to: **Bowling Green Campus:** Environmental Health and Safety, 1851 N. Research Drive  
Bowling Green, Ohio 43403, Phone: (419)372-2171, Fax:(419)372-2194  
**Firelands Campus:** Budget and Operations Office, 136 East Building, Huron, Ohio 44839  
Phone:(419)433-5560, Fax:(419)433-9696

<b>Part 1: Personal Status (Check One)</b>				
<input type="checkbox"/> Permanent Employee (full-time or part-time)	<input type="checkbox"/> Temporary Employee (BGSU or Employment Agency)	<input type="checkbox"/> Student Employee	<input type="checkbox"/> Student	<input type="checkbox"/> Visitor
<b>Part 2: Personal Information</b>				
Name (First, Middle, Last)			BGSU ID# P	
Home Address (number and street, city or town, state, and zip code)				
Home/Mobile Phone ( )	Campus/Mobile Phone ( )	Date of Birth	<input type="checkbox"/> Male <input type="checkbox"/> Female	
Department		Position or Title	Date of Hire	
<b>Part 3: Incident Information</b>				
Date <u>AND</u> time of injury, exposure <input type="checkbox"/> Check if time can not be determined		Time employee began work on date of injury _____ AM _____ PM	Was the injury, illness, or exposure on BGSU property? <input type="checkbox"/> Yes <input type="checkbox"/> No	
Building or area where injury occurred		Was the injury/illness job related? <input type="checkbox"/> Yes <input type="checkbox"/> No	Did it occur during overtime? <input type="checkbox"/> Yes <input type="checkbox"/> No	
Was there property damage? <input type="checkbox"/> Yes * <input type="checkbox"/> No *If Yes, please describe:				
Injury or Illness Classification:				
<input type="checkbox"/> Animal bite or sting	<input type="checkbox"/> Assault	<input type="checkbox"/> Heat burn	<input type="checkbox"/> Foreign object in eye	
<input type="checkbox"/> Chemical irritation/burn	<input type="checkbox"/> Cut	<input type="checkbox"/> Electrical shock	<input type="checkbox"/> Needlestick puncture	
<input type="checkbox"/> Repetitive motion	<input type="checkbox"/> Slip, trip or fall	<input type="checkbox"/> Strain or sprain		
<input type="checkbox"/> Struck by an object	<input type="checkbox"/> Exposure to blood	<input type="checkbox"/> Other (explain): _____		
<b>Specific</b> body parts affected? (For example: cut on the left thumb or sprain in the right ankle)			Did the injury result in death? <input type="checkbox"/> Yes <input type="checkbox"/> No Date of Death _____	
What happened? Describe how the injury or illness occurred (the work activity, equipment, and materials or chemicals involved).				
<b>Part 4: Witness(es) and Report Preparer Information (Attach additional sheet if needed)</b>				
Name(s), address(es) and phone number(s) of witness(es):				
Report prepared by:			Date prepared:	
Position/Title:			Phone:	

## Bowling Green State University Injury and Illness Follow-Up Report

Instructions: This follow-up report applies to **BGSU employees only**.

If not completed at the time of the injury and illness report, this follow-up report must be delivered or faxed to Environmental Health and Safety (Bowling Green Campus) or to the Budget and Operations Office (Firelands Campus) within **5 calendar days** of the date of the injury or illness.

Name:	Date of Injury/Illness:
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### Part 5: Medical Treatment

Did you seek medical treatment? <input type="checkbox"/> Yes (If yes, please fill out the rest of the page.) <input type="checkbox"/> No (Proceed to Part 7. If you seek medical attention in the future for this injury, please re-submit this page fully completed.)	
Were you treated in an emergency room? <input type="checkbox"/> Yes <input type="checkbox"/> No	Were you hospitalized overnight? <input type="checkbox"/> Yes <input type="checkbox"/> No
Name of Hospital or Urgent Care Center:	Phone Number: (    )
Treating Physician or Registered Professional:	Phone Number: (    )
Address(es) of Treating Physician or Registered Professional (number and street, city or town, state, and zip code)	
Description of Treatment (first aid treatment, cast/splint, stitches/wound glue, prescription medications, etc.):	

### Part 6: Did the Injury or Illness lead to any of the following situations?

List dates away from work ( <u>attach doctor's slip</u> ). <input type="checkbox"/> Not Applicable
List dates of restricted work when the employee remained at work and the health care professional recommended keeping the employee from performing the routine functions of his or her job or from working the full work day ( <u>attach doctor's slip</u> ). <input type="checkbox"/> Not Applicable
Were you transferred to another job? <input type="checkbox"/> Yes * <input type="checkbox"/> No        If Yes, please list the dates you were transferred:

### Part 7: Report Preparer Information

Report prepared By:	Date prepared:
Position/Title:	Phone:
Employee Signature ( <u>Required</u> )	
I certify that the above information is accurate to the best of my knowledge. By signing this form, I agree to the disclosure of my health information and authorize my medical providers to release information to Bowling Green State University and its representatives.	
Supervisor Signature ( <u>Required</u> )	

## The Laboratory Fume Hood

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### Purpose of a Fume Hood

Fume hoods are chemical containment devices used to control chemical emissions (and resulting exposures). The chemical emission is controlled by enclosing and containing the vapor or gas in the hood.

Laboratory operations involving toxic materials must be conducted within a laboratory hood. This protects the laboratory workers while performing experiments that generate toxic emissions.

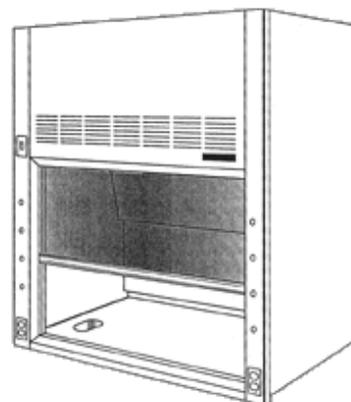


Figure 4: A Standard Hood

### Face Velocities

To provide adequate control of the emissions, a fume hood must provide an average face velocity of 100 feet per minute. Air velocities exceeding 120 feet per minute (fpm) and below 80 fpm can cause eddie currents. The eddie currents can release the chemical emissions into the laboratory and expose individuals without warning (Figure 5).

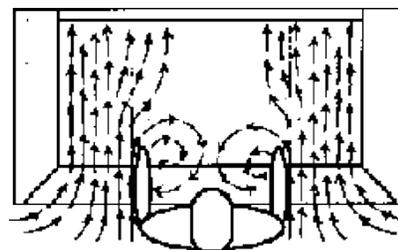


Figure 5: Overhead view of air flow patterns with a worker standing in front of a hood.

### Auxiliary-air fume hoods

Found mainly in the Physical Science Laboratory Building and Overman Hall, auxiliary air hoods (Figure 6) were developed to reduce energy consumption.

They function by supplying outside air near the top and front of the hood face. This is to minimize the conditioned laboratory air from being exhausted through the hood.

Auxiliary air hoods do not exhaust the laboratory air. Do not rely on these hoods to be a source of exhaust ventilation for laboratory air.

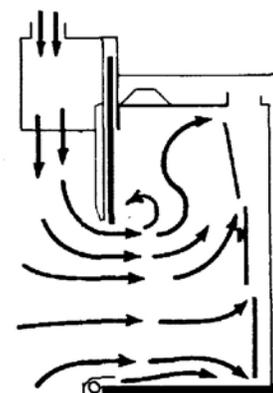


Figure 6: Cross section view of air flow with an auxiliary air hood.

## Laboratory Fume Hood Components and Functions (Figure 7)

Airfoil: Located along the bottom and sometimes the edges, airfoils streamline airflow into the hood preventing turbulent eddies that can carry vapors out of the hood. Bottom airfoils also provide a space for room airflow when the sash is completely closed.

Baffles: Movable or adjustable partitions used to create slotted openings along the back of the hood body. Baffles help to keep a uniform airflow across the face of the hood, which eliminates dead spots and optimizes capture efficiency.

Sash: A movable and transparent piece of Plexiglas that closes or opens the face of the hood.

Work Surface: The area under the hood where apparatuses and pieces of equipment are placed.

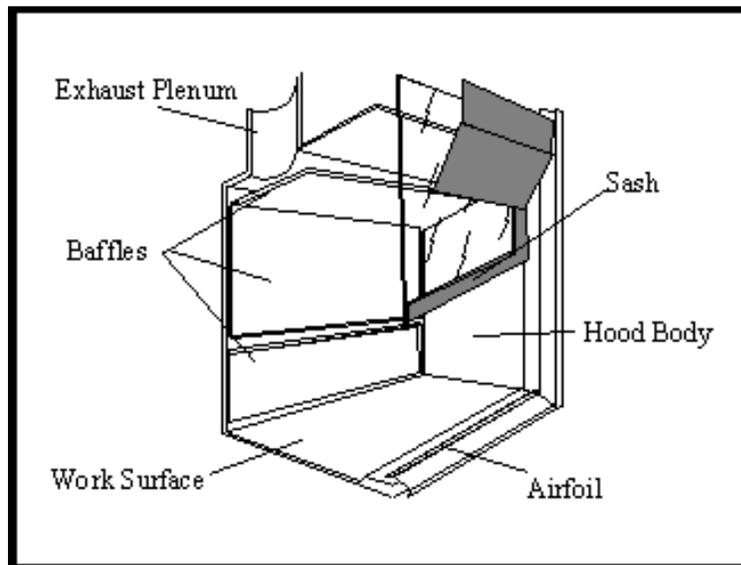


Figure 7: Components of a laboratory fume hood.

## How to properly use a Fume Hood

- Position the bottom of the sash to be in line with the 100 feet per minute arrow located on the side of the hood (Figure 8). The arrow is located where proper air flow velocities are achieved at the hood's face.
- Set up work inside the hood at least six inches from the face opening. (Figure 9) This will avoid turbulence at the sash edge and provide greater protection.
- Separate and elevate each instrument. Use blocks or racks to elevate equipment one to two inches off the hood work surface so that air can easily flow around all apparatuses with no disruption.
- Keep hood storage to an absolute minimum. Keep only items needed for ongoing operations inside the hood. Excess materials in the hood disrupt airflow and can act as a barrier or cause airflow to exit across the face of the hood. Keep the back bottom slot clear at all times as it serves as an exhaust port for fumes and heat generated near the surface.
- Minimize traffic near and around the hood. A person walking past the hood can create competing air currents. Other cross drafts should be eliminated, such as open doors or fans.
- Use extreme caution with ignition sources inside a fume hood. Ignition sources such as electrical connections and equipment, hot plates, controllers, and open flames will ignite flammable vapors or explosive particles that have generated inside the fume hood. All electrical equipment used inside a fume hood must be designed or certified as intrinsically safe, unless it can be absolutely established (and enforced) that flammable or explosive materials will not be used in a particular hood.
- Never put your head inside a hood while operations are in progress. The plane of the sash is the imaginary boundary that should not be crossed except to set up or dismantle equipment.
- Do not dismantle or modify the physical structure or exhaust system without consulting the Department of Environmental Health and Safety first. Modifications can result in a decrease in air flow and could make the hood less protective.
- Clean up spills as soon as possible.



Figure 8: Sash Position Arrow

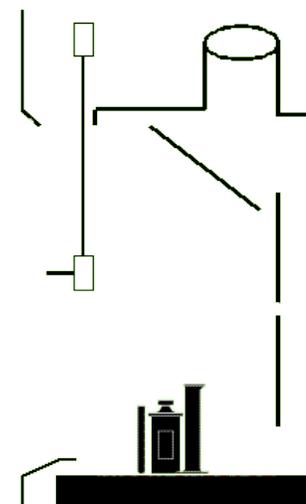


Figure 9: Glass wear located 6 inches in the hood.

## Health Hazards

### Toxic Substances

All chemical substances are lethal to the human body, just how lethal depends on the chemical's toxicity, amount of the substance and the amount of exposure time.

Toxicity is an adverse health effect resulting from a chemical exposure; this can be subdivided into two main groups as shown below.

- **Acute Toxicity:** Adverse health effects resulting from brief exposure to a chemical (e.g. seconds, minutes, hours). The effects generally involve short term, high concentrations and immediate results of some kind (illness, irritation, or death).

Chemicals that have acute health effects are described as toxic and highly toxic. It will only take a small amount of these chemicals to potentially cause death.

- **Chronic Toxicity:** Adverse health effects resulting from long-term exposure to a chemical (e.g. months, years, decades). The effects involve long term, low concentrations and delayed results of illness or disease.

Chemicals that have chronic health effects are characterized by prolonged or repeated exposure measured in a duration of weeks, months, or years. Symptoms of exposure may not be immediately apparent.

### Acutely Toxic Chemicals

Substances that display a high degree of acute toxicity have the ability to cause a harmful biological effect after a single or short exposure. Any compound that meets the criteria of "highly toxic" in Table 1 must be used following strict safety precautions.

**Table 1 - Acute Toxicity Hazard Level**

<b>Toxicity Rating</b>	<b>Oral LD<sub>50</sub> (Rats, per kg)</b>	<b>Skin Contact LD<sub>50</sub> (Rabbits, per kg)</b>	<b>Inhalation LC<sub>50</sub> (Rats, ppm for 1 h)</b>	<b>Inhalation LC<sub>50</sub> (Rats, mg/m<sup>3</sup> for 1 h)</b>
Highly Toxic	<50 mg	<200 mg	<200	<2,000
Toxic	50 to 500 mg	200 mg to 1 g	200 to 2,000	2,000 to 20,000
Slightly Toxic	500 mg to 5 g	1 to 5 g	2,000 to 20,000	20,000 to 200,000

LD<sub>50</sub>: The oral dose required to produce death in 50% of the exposed species.

LC<sub>50</sub>: The air born concentration of a given substance that when inhaled over a period of time will kill 50% of the exposed species.

Table 2 shows the relationship between the LD<sub>50</sub> values of test animals expressed as milligrams or grams per kilogram of body weight to the probable human lethal dose for a 70kg (150 lb) person.

**Table 2: Probable Lethal Dose for Humans**

<b>Toxicity Rating</b>	<b>Animal LD<sub>50</sub> (per kg)</b>	<b>Lethal Dose When Ingested by 70kg (150 lb) Human</b>
Extremely Toxic	Less than 5 mg	A taste (less than 7 drops)
Highly Toxic	5 to 50 mg	Between 7 drops and 1 teaspoon
Toxic	50 to 500 mg	Between 1 teaspoon and 1 ounce
Slightly Toxic	500 mg to 5 g	Between 1 ounce and 1 pint
Practically nontoxic	Above 5 g	Above 1 pint

### **Carcinogen**

A carcinogen is a material that either causes cancer in humans or in animals. If a material causes cancer in animals, it is considered capable of causing cancer in humans.

If the chemical is believed to be a carcinogen, the MSDS will list it in the Health Hazard Section under one of the following:

- NTP (National Toxicology Program)
- IARC (International Agency for Research on Cancer)
- OSHA (29 CFR Part 1910, Subpart X, Toxic and Hazardous Substances)

### **Reproductive Toxins**

Chemicals that have a harmful effect on the adult male or female reproductive systems or on the developing fetus or child are called reproductive toxins. If a chemical is believed to be a reproductive toxin, the MSDS will list it in the Health Hazard Section.

## Irritants

Chemicals that are capable of causing a reversible or irreversible inflammatory effect on the body at the site of contact as a function of concentration or duration of exposure is called an irritant. Irritants are not corrosive.

Some examples of irritants are:

Ammonium Dichromate	Potassium Hydroxide Solution 0.1N (N/10)
Bromobenzene	Propylene Carbonate
Diacetone Alcohol	Sodium Carbonate Anhydrous (Powder)
Methyl Ethyl Ketone	Tetrahydrofuran
Potash, Sulfurated (Lumps)	Zinc Sulfate Heptahydrate (Crystalline)

## Corrosives

Strong acids and bases are corrosive chemicals. They can destroy body tissue and can easily destroy skin. Corrosive chemicals are nucleophiles and electrophiles that break apart the proteins of the skin. Not only can these materials cause damage to body tissue, they can destroy metals, plastics, and other material on contact. Major classes of corrosive chemicals are strong acids and bases, dehydrating agents, and oxidizing agents.

Examples of corrosives include:

Ammonia (NH <sub>3</sub> )	Perchloric acid (HClO <sub>4</sub> )
Chromic acid (CrO <sub>3</sub> )	Phosphoric acid (H <sub>3</sub> PO <sub>4</sub> )
Hydrochloric acid (HCl)	Potassium hydroxide (KOH)
Lithium hydroxide (LiOH)	Sodium hydroxide (NaOH)
Nitric acid (HNO <sub>3</sub> )	Sulfuric acid (H <sub>2</sub> SO <sub>4</sub> )

## Harmful

This health hazard (used primarily by Fisher Scientific) identifies a substance that presents a moderate risk to health by inhalation, ingestion, or skin absorption.

Examples of harmful substances are:

Ammonium Chloride	Methylene Chloride
Benzaldehyde	Petroleum Ether
Ethylene Glycol	Rosin
Hexamethylenetetramine	Toluene
Iodine	Xylenes

## Physical Hazards

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### Flammable Liquid

A liquid is considered flammable when it gives off vapors readily ignitable at room temperature. A liquid with a flash point below 100° F (38° C) is classified as a flammable liquid.

Flash point: the lowest temperature at which a flammable liquid gives off sufficient vapor to form an ignitable mixture with air near its surface or within a vessel.

### Combustible Liquid

A combustible liquid is a term used to classify certain materials with low flash points that ignite easily. The liquid is considered combustible if it has a flash point at or above 100° F (38° C) but below 200° F (93.3° C).

### Compressed Gas

A compressed gas is a gas at normal temperature and pressure, and contained under pressure as a dissolved gas or liquefied by compression or refrigeration.

### Oxidizer

An oxidizer is a chemical that initiates or promotes combustion in other materials, thereby causing fire either of itself or through the release of oxygen or other gases.

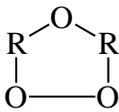
The following are examples of materials that are powerful oxidizing reagents:

Ammonium perchlorate	Dibenzoyl peroxide	Potassium chlorate
Ammonium permanganate	Fluorine	Potassium perchlorate
Barium peroxide	Hydrogen peroxide	Potassium peroxide
Bromine	Magnesium perchlorate	Propyl nitrate
Calcium chlorate	Nitric acid	Sodium chlorate
Calcium hypochlorite	Nitrogen peroxide	Sodium chlorite
Chlorine trifluoride	Perchloric acid	Sodium perchlorate
Chromium anhydride	Potassium bromate	Sodium peroxide

## Explosive

Some substances are very sensitive to abrupt shock, high temperature, or to an ignition source. These substances are explosive because they produce a sudden, almost instantaneous release of pressure, gas, and heat when exposed to shock, high temperature, or an ignition source.

Below are functional groups that can be explosive in some compounds:

Acetylide	$R-C\equiv C-Metal$	Nitro	$R-NO_2$
Peroxide	$R-O-O-R$	Diazonium Salts	$R-N\equiv N^{\oplus}$
Azide	$R-N=N=N$	Ozonide	
Nitroso	$R-N=O$		

## Ultraviolet Light

Ultraviolet light has the ability to interact with various macromolecules in the skin and eye and produce damage. Exposing the skin to ultraviolet light can cause erythema (redness of the skin), photosensitivity, and cancer. The IARC has found that ultraviolet light in all UV regions are probably carcinogenic to humans. The eye is also impacted from unprotected exposure to ultraviolet light. The cornea and conjunctiva absorbs various wavelengths of ultraviolet light and can cause photokeratitis and photoconjunctivitis from acute exposures.

## Organic Peroxides and Peroxide Formers

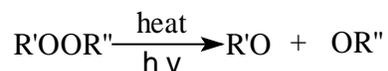
Chemicals containing the bivalent –O-O- structure, which is a structural derivative of hydrogen peroxide (H<sub>2</sub>O<sub>2</sub>) where one or both hydrogen atoms are replaced by an organic radical, are organic peroxides. These compounds are reactive and unstable because of shock, pressure, or temperature.

Peroxides can be highly reactive and flammable and powerful oxidizers. The oxygen-oxygen bond is a weak bond and can be cleaved from the energy generated by mechanical shock, heat, light, or chemical contact.

**Average Bond Energies (kcal/mol)**

C≡O 257	<sup>3</sup> (O=O) 119	C—O 86	Br—Br 46
N≡N 226	O—H 111	C—C 83	N—N 39
C≡N 213	H—H 104	C—Cl 81	I—I 36
C≡C 200	H—Cl 103	C—N 73	O—O 35
C=O 179	N=N 100	H—I 71	
C=N 147	C—H 99	C—Br 68	
C=C 146	N—H 93	Cl—Cl 58	
H—F 135	H—Br 87	C—I 51	

Free radicals are formed from the broken oxygen – oxygen bond. The free radicals are highly reactive as well. A large amount of energy is released during the decomposition of the chemical.



There are generally three classes of chemicals that can form peroxides. The degree of explosion hazard depends on the the chemical and the condition in which it is stored and used.

*Class A*

Peroxidizable compounds that form explosive compounds without being concentrated.

Organic

Divinyl ether  
Divinyl acetylene  
Isopropyl ether  
Vinylidene

Inorganic

Potassium metal  
Potassium Amide  
Sodium amide (sodamide)

*Class B*

Chemicals that present a peroxide hazard when they are concentrated via distillation or evaporation. Specific distillation and evaporation procedures must be performed.

Acetal  
Cumene  
Cyclohexene  
Cyclooctene  
Cyclopentene  
Diacetylene  
Dicyclopentadiene  
Diethylene glycol dimethyl ether  
Diethyl ether

Dioxane (p-dioxane)  
Ethylene glycol dimethyl ether (glyme)  
Furan  
Methyl acetylene  
Methyl cyclopentane  
Methyl-*i*-butyl ketone  
Tetrahydrofuran  
Tetrahydronaphthalene  
Vinyl ethers

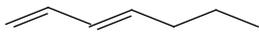
*Class C*

Unsaturated materials that may polymerize violently and hazardously due to peroxide initiation.

Acrylic acid  
Acrylonitrile  
Butadiene  
Chlorobutadiene (Chloroprene)  
Chlorotrifluoroethylene  
Methyl methacrylate  
Styrene

Tetrafluoroethylene  
Vinyl acetate  
Vinyl acetylene  
Vinyl chloride  
Vinyl pyridine  
Vinylidene chloride

Certain classes of chemicals are more prone to forming peroxides than others. Here are some examples of chemicals and how likely they are to form peroxides.

Likelihood to form peroxides	Type of Chemical	Prefix or Suffix	Example
High   Low	Ethers	Alkyl ether	$R-O-R'$
	Acetals		$\begin{array}{c} OCH_3 \\   \\ H_3C-C-H \\   \\ OCH_3 \end{array}$
	Olefines ( Alkenes)	-ene	$\begin{array}{c} R & & R \\ & \backslash & / \\ & C=C \\ & / & \backslash \\ R & & R \end{array}$
	Halogenated Olefines (Halogenated alkenes)	-ene	$\begin{array}{c} X & & R \\ & \backslash & / \\ & C=C \\ & / & \backslash \\ R & & R \end{array}$
	Vinyl compounds	vinal -	$\begin{array}{c} H & & H \\ & \backslash & / \\ & C=C \\ & / & \backslash \\ R & & H \end{array}$
	Dienes	-diene	
	Alkynes	-yne	$R-C\equiv C-R$
	Alkybenzenes		
	Isoparaffins		
	Secondary alcohols	-anol	$R-OH$
	Keytones	-anone	$\begin{array}{c} O \\    \\ R-C-R' \end{array}$
	Aldehydes	-anal	$\begin{array}{c} O \\    \\ R-C-H \end{array}$
	Ureas		
Amides	-amine	$RNH_2, R_2HN, R_3N$	

### Testing for the presence of peroxides

Classes A, B, and C must be tested for the presence of peroxides every three months. The chemical must be either redated as safe if no peroxides are present or disposed of through the University's Hazardous Waste Program.

#### **Aqueous Peroxide Test Method**

1. Add 1 to 3 mL of liquid to be tested in an equal volume of acetic acid.
2. Add a few drops of 5% aqueous potassium iodide solution.
3. Stir. Do not let the mixture touch your skin.

The appearance of a yellow to brown color indicates the presence of peroxides.

A yellow color indicates a low concentration of peroxides (less than 100 ppm). A brown color indicates a high concentration of peroxides (greater than 100 ppm).

- Chemicals containing concentrations below 100 ppm, may be treated to remove the peroxide contamination and stored for future use. Refer to the peroxide treatment section for details.
- Chemicals containing more than 100 ppm of peroxides must be disposed of immediately through the University's Hazardous Waste Program. Contact 372-2171 for more information.

#### **Peroxide Test Strips**

1. Use a peroxide test strip to test for the presence of peroxides.
- Chemicals containing concentrations below 100 ppm, may be treated to remove the peroxide contamination and stored for future use. Refer to the peroxide treatment section for details.
  - Chemicals containing more than 100 ppm of peroxides must be disposed of immediately through the University's Hazardous Waste Program. Contact 372-2171 for more information.

### Removal of Peroxides

This procedure must only be used for chemical solutions that contain less than 100 ppm of peroxides. Solutions greater than 100 ppm must be disposed of through the University's Hazardous Waste Program.

#### **Activated Alumina Column Removal**

1. Prepare a column of activated alumina.
2. Pour the peroxide containing solution through the column.
  - Do not allow the column to dry out while in use.
3. Re-test for the presence of peroxides. If peroxides are still present, pass it through the column until you can not detect them.
4. When the alumina column is no longer effective at removing the peroxides, wash the column with 5% aqueous ferrous sulfate and discard the solution as hazardous waste.

### Distillation and Evaporation Procedures

This procedure must be used for Class A , B and C materials.

1. Test for the presence of peroxides.
  - If greater than 100 ppm, discard as hazardous waste.
  - If less than 100 ppm, treat until you can not detect the presence of peroxides.
2. Before distilling any Class C material, a suitable polymerization inhibitor must be added.
3. An explosion shield must be used by placing it between the evaporation or distillation process and the operator.
4. Safety goggles must be worn by the operator.
5. Evaporate or distill and leave at least 10% of the solution in the container. Most accidents occur when the material is nearly a dry residue.
  - Use a boiling aid or magnetic stirrer before you use a nitrogen bleed to maintain ebullition.
  - In operations using higher boiling peroxidizable compounds under reduced pressure, an explosive mixture can result because the boiling temperature may be lower than the peroxide decomposition temperature. Contact EH&S (372-2171) when performing an operation of this type.

### **Implosion Hazards**

#### Vacuum Work and Rotary Evaporators

Rotary evaporators under vacuum conditions can implode. Glass components of the apparatus should be wrapped with electrical tape. The unit must be enclosed in a shield to guard against flying glass in the event of an implosion.



## Radioactive Materials

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Use of radioactive material is prohibited by anyone who has not had the proper training and orientation. Direct any questions regarding the use of radioactive materials to the Radiation Safety Officer in the Department of Environmental Health and Safety (372-2171).

Normal research and instructional activities do not present a danger to individuals working in or visiting laboratories where radioisotopes are used. Individuals who use radioisotopes must follow the procedures outlined in the BGSU Radiation Safety Manual.

Laboratories where radioactive materials are used are regularly monitored and checked for cleanliness by the BGSU Radiation Safety Officer. Labs that use radioactive materials have signs posted indicating they are being used. See figure 18.



Figure 18:  
Radiation Area

Within the laboratories that use radioisotopes, specific locations are marked where such materials are stored or used. Typically, lab benches in these areas will be bordered with special tape (Figure 19) indicating that radioisotopes are used there, and these lab benches will be covered with special absorbent paper to collect any spills. Sinks where radioactive materials are disposed or prepared will also be marked with a sign to this effect. Special trash containers made from lucite plastic, which is effective for radiation shielding are also located in these laboratories.



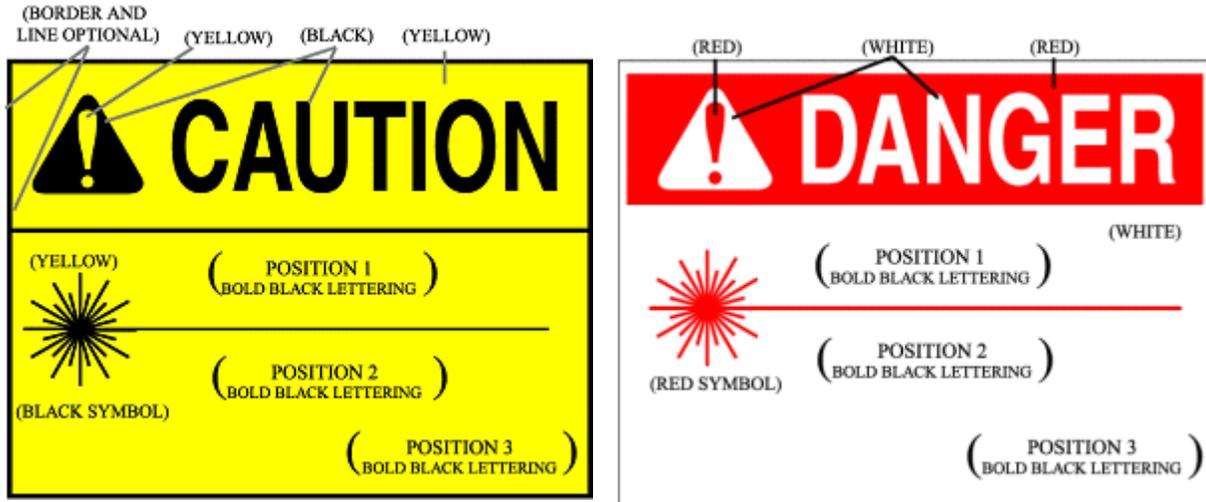
Figure 19: Radioactive Material Tape

While in a laboratory with radioactive isotopes:

- Do not eat, drink, chew gum, or apply cosmetics.
- Do not take water from a sink used for isotope disposal.
- Do not clean up laboratory benches that are identified as areas of radioactive isotope usage.
- Do not remove radioactive waste from the laboratory.

## Laser Hazards

There are many different types of lasers. The radiation from each laser is classified into one of four classifications. Each classification is based on the energy output of the laser and the health effects of exposure to a laser in the classification.



- Position 1 Information in this location informs one of the special precautionary instructions and actions that need to be taken by a person entering the area where the laser is used.
- Position 2 The type of laser in the area is identified here. (Nd:YAG, Helium-Neon, etc.)
- Position 3 The class of laser or laser system is identified here. ( Class 1, 2, 3a, 3b, 4)

Class	Description	Signal Word
1	These are typically used in laser pointers and CD players. They are low power lasers and a direct beam into the eye could not cause damage.	-
2	These lasers produce visible light and generate beams of less than 1 milliwatt. They are used in supermarket scanners. This class of lasers can be a hazard to the eye if a person stares directly into the beam and does not blink.	Caution
3a	These lasers have a typical power output of 1 to 5 milliwatts. This class of lasers can be a hazard to the eye if a person stares directly into the beam and does not blink. Direct viewing of the beam with focusing optical instruments can also cause eye damage.	Caution / Danger
3b	These lasers have a typical power output of 5 to 500 milliwatts. Eye injury can occur from direct and reflected beam viewing.	Danger
4	These lasers have a typical power output of greater than 500 milliwatts. In addition to producing eye injuries, this class is capable of producing skin injuries from direct and reflected beams.	Danger

## **Chemical Labeling**

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The goal of proper chemical labeling is the identification of chemicals and their hazards. With properly labeled chemicals, unlabeled containers are avoided, keeping disposal costs low.

- Labels on incoming containers from manufactures shall not be removed or defaced.
- Labels on secondary containers (containers not intended for immediate use) shall identify the chemical's name and the hazard warnings (health and physical hazards) associated with that chemical.
- Containers for immediate use, such as beakers and flasks, must at a minimum be labeled with the name of the chemical contents.

## Hazardous Materials Information System

The Hazardous Materials Information System (HMIS) is a color and number system. The system uses a color-coded square with four rows in which numbers are used to signal the degree of health hazard, flammability hazard, and reactivity hazard. A letter in the bottom row is used to indicate the personal protective equipment that should be used with the chemical. Refer to the HMIS Personal Protection Index. An asterisk (\*) indicates chronic health hazards are associated with the chemical.



<b>Hazard Rating</b>	<b>Health Hazard (blue)</b>	<b>Flammability Hazard (red)</b>	<b>Reactivity Hazard (yellow)</b>
<b>4 Severe Hazard</b>	Substance considered highly toxic under OSHA's Hazard Communication Standard.	Substance considered a flammable liquid under OSHA's Hazard Communication Standard.	Substance that in itself is readily capable of detonation or explosive decomposition or explosive reaction at normal temperatures and pressures. This includes substances that are sensitive to localized thermal or mechanical shock at normal temperatures and pressures. Substance considered explosive under OSHA's Hazard Communication Standard.
<b>3 Serious Hazard</b>	Substance considered highly toxic under OSHA's Hazard Communication Standard. Substances can be severely irritating or corrosive to skin. Substances can be corrosive and cause irreversible destruction to eyes.	Substance considered a flammable liquid under OSHA's Hazard Communication Standard.	Substance that in itself is capable of detonation or explosive reaction, but that require a strong initiating source or must be heated under confinement before initiation. Substance considered explosive under OSHA's Hazard Communication Standard.
<b>2 Moderate Hazard</b>	Substance considered toxic under OSHA's Hazard Communication Standard. Substances moderately irritating and considered to be a primary skin irritant or sensitizer. Substances moderately to severely irritating to the eyes. May be reversible.	Substance considered a combustible liquid under OSHA's Hazard Communication Standard.	Substance normally undergoes a violent chemical change at elevated temperatures and pressures. Substance considered explosive under OSHA's Hazard Communication Standard.
<b>1 Slight Hazard</b>	Substance not considered toxic under OSHA's Hazard Communication Standard. Substances slightly or mildly irritating to the skin. Slightly or mildly irritating to the eyes and reversible within 7 days.	Substance considered a combustible liquid under OSHA's Hazard Communication Standard.	Normally stable material but becomes unstable at elevated temperatures and pressures. Substance considered explosive under OSHA's Hazard Communication Standard.
<b>0 Minimal Hazard</b>	Substance not considered toxic under OSHA's Hazard Communication Standard. Essentially non-irritating to the skin and eyes.	Substance will not burn. Substance not considered flammable or combustible under OSHA's Hazard Communication Standard.	Normally stable materials that do not react with water. Substance not considered explosive under OSHA's Hazard Communication Standard.

### HMIS Personal Protection Index

<b>A</b>		Safety glasses
<b>B</b>		Safety glasses and gloves
<b>C</b>		Safety glasses, gloves, and apron
<b>D</b>		Face shield, eye protection, gloves, and apron
<b>E</b>		Safety glasses, gloves, dust respirator
<b>F</b>		Safety glasses, gloves, apron, and dust respirator
<b>G</b>		Safety glasses, gloves, vapor respirator
<b>H</b>		Splash goggles, gloves, apron, and vapor respirator
<b>I</b>		Safety glasses, gloves, dust and vapor respirator
<b>J</b>		Splash goggles, gloves, apron, dust and vapor respirator
<b>K</b>		Airline hood or mask, gloves, full suit, and boots

  
A - Safety glasses

  
N - Splash goggles

  
O - Face Shield & Eye Protection

  
P - Gloves

  
Q - Boots

  
R - Apron

  
S - Full Suit

  
T - Dust mask

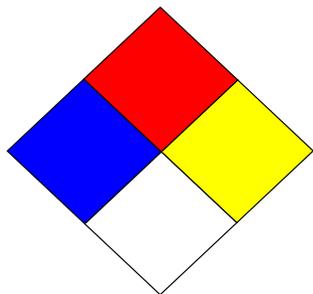
  
U - Vapor Respirator

  
W - Dust & Vapor Respirator

  
Y - Full Face Respirator

  
Z - Airline Hood or Mask

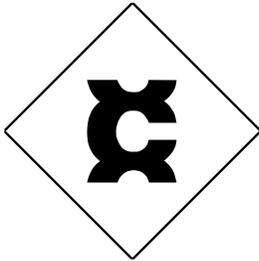
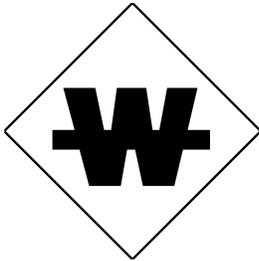
## National Fire Protection Association



The National Fire Association (NFPA) has developed a color-coded number system called NFPA 704. The system uses a color-coded diamond with four quadrants in which numbers are used in the upper three quadrants to signal the degree of health hazard (blue), flammability hazard (red), and reactivity hazard (yellow). The bottom quadrant is used to indicate special hazards. The NFPA system is good for alerting personnel of the degree of hazard of the chemical and helpful in drawing attention to storage needs and the necessary emergency equipment needed. This system does not indicate chronic health hazards.

<b>Hazard Rating</b>	<b>Health Hazard (blue)</b>	<b>Flammability Hazard (red)</b>	<b>Stability Hazard (yellow)</b>
<b>4 Severe Hazard</b>	Substance considered highly toxic under OSHA's Hazard Communication Standard. Under emergency conditions, these substances can be lethal.	Substance considered a flammable liquid under OSHA's Hazard Communication Standard.	Substance that in itself is readily capable of detonation or explosive decomposition or explosive reaction at normal temperatures and pressures. This includes substances that are sensitive to localized thermal or mechanical shock at normal temperatures and pressures. Substance considered explosive under OSHA's Hazard Communication Standard.
<b>3 Serious Hazard</b>	Substance considered highly toxic under OSHA's Hazard Communication Standard. Under emergency conditions, this substance can cause serious or permanent injury.	Substance considered a flammable liquid under OSHA's Hazard Communication Standard.	Substance that in itself is capable of detonation or explosive decomposition or explosive reaction, but that require a strong initiating source or must be heated under confinement before initiation. Substance considered explosive under OSHA's Hazard Communication Standard.
<b>2 Moderate Hazard</b>	Substance considered toxic under OSHA's Hazard Communication Standard. Under emergency conditions, this substance can cause temporary incapacitation or residual injury.	Substance considered a combustible liquid under OSHA's Hazard Communication Standard.	Substance normally undergoes a violent chemical change at elevated temperatures and pressures. Substance considered explosive under OSHA's Hazard Communication Standard.
<b>1 Slight Hazard</b>	Substance not considered toxic under OSHA's Hazard Communication Standard. Under emergency conditions, this substance can cause significant irritation.	Substance considered a combustible liquid under OSHA's Hazard Communication Standard.	Normally stable material but become unstable at elevated temperatures and pressures. Substance considered explosive under OSHA's Hazard Communication Standard.
<b>0 Minimal Hazard</b>	Substance not considered toxic under OSHA's Hazard Communication Standard. Under emergency conditions, this substance would offer no hazard beyond that of ordinary combustible material.	Substance is not considered combustible or flammable under OSHA's Hazard Communication Standard. Substance that will not burn.	Normally stable material that does not react with water. Substance not considered explosive under OSHA's Hazard Communication Standard.

Special Hazards

 <p><b>ACID</b></p> <p>Acid</p>	 <p><b>ALK</b></p> <p>Alkali</p>
 <p>Biohazard</p>	 <p>Carcinogen</p>
 <p><b>COR</b></p> <p>Corrosive</p>	 <p>Use <b>NO WATER</b></p>
 <p><b>OXY</b></p> <p>Oxidizer</p>	 <p>Radiation Hazard</p>

## Hazard Communication Standard Pictograms

As of June 1, 2015, the Occupational Safety and Health Administration (OSHA) continues to update the Hazard Communication Standard (HCS) and will require pictograms on labels to alert users of the chemical hazards to which they may be exposed. Each pictogram consists of a symbol on a white background framed within a red border and represents a distinct hazard(s). The pictogram on the label is determined by the chemical hazard classification.

### Pictographs of Chemical Hazards

<p><b>Health Hazard</b></p>  <ul style="list-style-type: none"> <li>• Carcinogen</li> <li>• Mutagenicity</li> <li>• Reproductive Toxin</li> <li>• Respiratory Sensitizer</li> <li>• Target Organ Toxicity</li> <li>• Aspiration Toxicity</li> </ul>	<p><b>Flame</b></p>  <ul style="list-style-type: none"> <li>• Flammables</li> <li>• Pyrophorics</li> <li>• Self-Heating</li> <li>• Emits Flammables Gas</li> <li>• Self-Reactives</li> <li>• Organic Peroxides</li> </ul>	<p><b>Exclamation Mark</b></p>  <ul style="list-style-type: none"> <li>• Irritant (Skin and Eye)</li> <li>• Skin Sensitizer</li> <li>• Acute Toxicity (harmful)</li> <li>• Narcotic Effects</li> <li>• Respiratory Tract Irritant</li> <li>• Hazardous to ozone layer (non-mandatory)</li> </ul>
<p><b>Gas Cylinder</b></p>  <ul style="list-style-type: none"> <li>• Gases Under Pressure</li> </ul>	<p><b>Corrosion</b></p>  <ul style="list-style-type: none"> <li>• Skin Corrosion/Burns</li> <li>• Eye Damage</li> <li>• Corrosive to Metals</li> </ul>	<p><b>Exploding Bomb</b></p>  <ul style="list-style-type: none"> <li>• Explosives</li> <li>• Self-Reactives</li> <li>• Organic Peroxides</li> </ul>
<p><b>Flame Over Circle</b></p>  <ul style="list-style-type: none"> <li>• Oxidizers</li> </ul>	<p><b>Environment</b></p>  <ul style="list-style-type: none"> <li>• Aquatic Toxicity</li> </ul>	<p><b>Skull and Crossbones</b></p>  <ul style="list-style-type: none"> <li>• Acute Toxicity (fatal or toxic)</li> </ul>

## Standard Laboratory Procedures

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There are several standard laboratory procedures that all laboratories must follow. These standard laboratory procedures will help reduce the risk of hazards present in the laboratory. A list of standard laboratory procedures is included in this section.

### Behavior

- Behave professionally at all times.
- Do not engage in horseplay.

### Personal Attire

- Wear closed toe shoes in laboratories. Sandals are not permitted.
- Do not wear porous or absorbent watch straps in laboratories.
- Avoid excessively loose or baggy attire, which may include loose sleeves, long neck ties, long unrestrained hair, and hanging jewelry.

### Personal Hygiene

- Do not apply cosmetics in the lab.
- Do not eat or drink in the lab.
- Do not store food in lab refrigerators.
- Do not drink from eye wash station.
- Do not use lab glassware for holding food or drink.
- Avoid skin contact with chemicals.
- Wash hands often while in the lab and thoroughly before leaving.

### General Guidelines

- Chemical containers shall not be stored on floors.
- Store dry chemicals on shelves.
- Store flammables together. Use approved flammable storage cabinets. If possible, they should be ventilated.
- Store acids and bases separately in chemical resistant cabinets. In labs with less space, acids and bases can be stored in the same cabinet but separated by plastic trays.
- Exception: Nitric acid, when combined with acetic acid on a tile/concrete floor, may create a fire. Therefore Nitric acid shall not be stored with acetic acid.
- Oxidizers and toxic substances should be stored near a hood.
- Store general cleaning materials under the sink.

### Chemical Handling

- Never smell or taste chemicals.
- Always assume a chemical is hazardous.
- Never use chipped or broken glassware.
- Always place chemicals back from the edge of shelves, tables or benches.
- Keep work area clear and uncluttered.
- Do not pipette by mouth.
- Use only the amount needed.
- Waste chemicals will be handled in accordance with the University's Hazardous Waste Program.

### Contact Lenses

- Contact lenses shall not be worn as a means of eye protection inside laboratories.

### **Eye Protection**

- Wear safety goggles while engaged in laboratory activities.
- Wear safety goggles that conform to ANSI Standard Z87.1.
- Wash safety goggles often with mild soap and water.
- In event of a chemical splash into the eye, flush with water for a minimum of 15 minutes and seek medical attention.

### **Face Shields**

- Use face shields when significant splash hazards exist or other times when appropriate.
- Wash face shields often with mild soap and water.

### **Gloves**

- Wear appropriate gloves whenever using particularly hazardous chemicals or chemicals with significant skin damaging or skin absorption potential.
- Inspect gloves for tears before use.
- Follow the glove use recommendations established by the glove manufacturer.

### **Laboratory Coats and Aprons**

- Wear appropriate protective clothing when using particularly hazardous chemicals or when working with large volumes of a chemical.

### **Respiratory Protection**

- Use respiratory protection to control exposure to hazardous chemicals when other control measures (i.e. lab hoods or general ventilation) are insufficient to reduce chemical exposures below the acceptable level. Any use of respiratory protection equipment must comply with BGSU's Respiratory Protection Program including medical clearance for use, training, and fit testing.

### **Fire Safety**

- Open flames are permitted in laboratories when they are actively being used for experimentation and/or research purposes under the supervision of a Principal Investigator or laboratory worker.
- If using natural gas as a fuel source, know where the shut off valve is located in the event of an emergency.
- A striker should be used to ignite the flame. Do not use lighters to ignite flame sources in laboratories.
- Be aware of fire procedures including evacuation routes and location and use of portable fire extinguishers.
- Contact the Department of Environmental Health and Safety for fire extinguisher training.

### **Phones and Emergency Numbers**

- Know the location of the nearest phone and numbers to call in case of an emergency, including the phone number of the Principal Investigator for the lab.
- Have the BGSU Emergency Procedures Poster located by the phone.

### **Labeling**

- Label hot surfaces.
- Do not remove or deface labels on incoming containers from manufacturers.
- Identify the chemical's name and the health warnings associated with that chemical on labels for secondary containers.
- Label containers for immediate use, such as beakers and flasks, with the name of the chemical contents.
- Label all containers to avoid orphaned containers of unknown material that present a hazard.

### **Safety Data Sheets (SDS)**

- SDSs for all chemicals used in the laboratory shall be maintained in a readily accessible location for laboratory employees. They are located in \_\_\_\_\_ by \_\_\_\_\_.

### **Working alone**

- Avoid working alone. If it must be done, have a check-in system.

### **Alarms**

- Know what fire and emergency alarms sound like and what the appropriate actions are. Refer to BGSU's Emergency Procedures.

### **Hazardous Procedures**

- Inform co-workers when performing hazardous procedures.

### **Safety Inspections**

- Review the results of safety inspections and take corrective actions.
- Report all safety deficiencies to the laboratory's Principal Investigator.

### **Laboratory Hoods**

- Keep hoods free of clutter.
- Do not use hoods for general chemical storage. Only chemicals that require ventilation while in storage may be stored in a hood specified for that purpose.
- Position gas phase or particle generating sources well within hood.

### **Local Exhaust Ventilation**

- Position local exhaust systems (glove boxes, flexible ductwork, etc.) to capture noxious agents and prevent system leakage into the laboratory.

### **Electrical**

- Do not remove the ground plug on three-prong electric plugs. Do not modify or use in two-prong outlets. Make sure all pieces of electrical equipment are grounded prior to use.

### **Sharps**

- Dispose of broken glass and other sharps in appropriate, labeled containers.

### **Storage of Chemicals**

- Only authorized individuals should have access to chemicals.
- Store chemicals in designated storage areas and in approved NFPA storage cabinets.
- Keep boxes containing chemicals separate. Do not stack them.
- Use only explosion-proof refrigerators to store liquids, which could produce explosive vapor concentrations.
- Secure compressed gas cylinders by chain or strap. Keep protective caps on cylinders not in use. Identify status of cylinders (i.e. full, in-use, empty).
- Segregate incompatible materials to prevent contact with one another.

### **Maintenance**

- Keep lab clean and uncluttered.
- Inspect and maintain laboratory equipment regularly.

## Chemical Storage Guidelines

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Figure 20: Sample Storage Cabinets

## **Flammable Liquid Storage**

The presence of flammable liquids in the laboratory presents a significant potential for fires and explosions in the laboratory. To minimize the potential for fires and explosions, flammable liquids must be stored in flammable safety cabinets. Flammable storage cabinets do not need to be ventilated for fire protection. However, they can be ventilated to control odors.

## **Refrigerated Flammable Liquid Storage**

Using domestic refrigerators and freezers for storage of flammable material is prohibited. Flammable vapors can accumulate in domestic refrigerators and freezers. When flammable vapor accumulates to a specific level and a source of ignition is provided (a thermostat, light switch, etc.), a fire or explosion can result.

Flammable liquids may only be stored in refrigeration equipment that is *explosion proof*, *explosion safe*, *laboratory safe*, or designated for *flammable material storage*. These refrigeration units must be approved by Underwriters Laboratory as acceptable for storage of flammable liquids.

## Chemical Manufacturer Suggested Chemical Storage Pattern

Storage of laboratory chemicals presents an ongoing safety hazard. There are many chemicals that are incompatible with each other. The common method of storing these products in alphabetical order sometimes results in incompatible neighbors. For example, storing strong oxidizing materials next to organic chemicals can present a hazard.

A possible solution is to separate chemicals into their organic and inorganic families and then to further divide the materials into related or compatible families. Below is a list of compatible families.

<u>Inorganic</u>	<u>Organic</u>
1. Metals, Hydrides	1. Acids, Amino Acids, Anhydrides, Peracides
2. Acetates, Halides, Iodides, Sulfates, Sulfites, Thiosulfates, Phosphates, Halogens	2. Alcohols, Glycols, Sugars, Amines, Amides, Imines, Imides
3. Amides, Nitrates (except Ammonium Nitrate) Nitrites, Azides	3. Hydrocarbons, Esters, Aldehydes, Oils
4. Hydroxides, Oxides, Silicates, Carbonates, Carbon	4. Ethers, Ketones, Ketenes, Halogenated Hydrocarbons, Ethylene Oxide
5. Sulfides, Selenides, Phosphides	5. Epoxy Compounds, Isocyanates
6. Chlorates, Bromates, Iodates, Chlorites, Hypochlorites, Perchlorates, Perchloric Acid, Peroxides, Hydrogen Peroxide	6. Peroxides, Hydroperoxides, Azides
7. Arsenates, Cyanides, Cyanates	7. Sulfides, Polysulfides, Sulfoxides, Nitriles
8. Borates, Chromates, Manganates, Permanganates	8. Phenols, Cresols
9. Acids (except Nitric Acid. Store Nitric Acid on an isolated shelf by itself)	9. Dyes, Stains, Indicators
10. Sulfur, Phosphorus, Arsenic, Phosphorus Pentoxide	

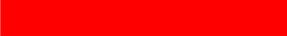
**Note:** Volatile materials (ethers, hydrocarbons, etc.) must be stored in an explosion-proof refrigerator. The thermostat switch or light switch in a standard refrigerator may spark and set off the volatile vapor inside and thus cause an explosion.

This list is not a complete list and is intended only to cover the materials possibly found in an average laboratory setting. This is not the only method of arranging these materials and is purely offered as a suggestion.

## Fisher Scientific Suggested Storage Pattern



A color-coded bar on the label of every Fisher chemical provides an instant guide to storage. The storage code color is also denoted by its initial, and spelled out for additional clarification. The five storage colors and their descriptions are as follows:

 **Flammable.** Store in area segregated for flammable reagents.

RED (R)

 **Health Hazard.** Toxic if inhaled, ingested, or absorbed through Skin. Store in secure area.

BLUE (B)

 **Reactive and Oxidizing Reagents.** May react violently with air, water, or other substances. Store away from flammable and combustible materials

YELLOW (Y)

 **Corrosive.** May harm skin, eyes, mucous membranes. Store away from red-, yellow-, and blue-colored reagents above.

WHITE (W)

 Presents no more than moderate hazard in any of categories above. For general chemical storage.

GREY (G)

**Exception.** Denoted by the word “STOP.” Reagents Incompatible with other reagents of the same color bar. Store separately.

## **Particularly Hazardous Substances**

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Additional care is required for any use of substances that are particularly hazardous. Substances of this type include:

- Carcinogens
- Reproductive Toxins
- Substances with a high degree of acute toxicity

### **Special Procedures**

When working with a PHS, four steps must be taken:

- Establishment of a designated area for use;
- Use of containment devices such as laboratory fume hoods or glove boxes;
- Acceptable plans for safe removal of waste; and
- Establishment of procedures for decontamination of material, area, and workers that contact the substance.

### **Prior Approval**

Prior approval is required before beginning work using a particularly hazardous substance. Approval must be secured from the Principal Investigator (See BGSU's Chemical Hygiene Plan).

### **Substances with Unknown Hazards**

When a chemical with an unknown hazard is brought into or produced in the laboratory, the substance must be handled as a particularly hazardous substance.

When it has been demonstrated that a substance is not a particularly hazardous substance, the requirements of this section no longer applies.

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## Determining what chemicals classify as a Particularly Hazardous Substance

Chemicals that fall under the classification of “Carcinogen” will be identified on the MSDS as:

- IARC Group 1
- IARC Group 2A
- IARC Group 2B
- Known to be a carcinogen by NTP
- Reasonably anticipated to be a carcinogen by NTP
- OSHA carcinogen

### Examples of Chemicals that are Carcinogens and are Particularly Hazardous Substances

Acetaldehyde	Dimethyl sulfate
2-Acetylaminofluorene	<b>1,4-Dioxane</b>
<b>Acrylamide</b>	Ethyl carbamate (urethane)
Acrylonitrile	Ethylene dibromide
Aflatoxins	Ethylene oxide
4-Aminobiphenyl	Ethylenimine
Arsenic & certain arsenic compounds	<b>Formaldehyde</b>
Azathioprine	Hexamethylphosphoramide
Barium chromate	Hydrazine
<b>Benzene</b>	Melphalan
Benzidine	4,4'-Methylene-bis[2-chloroaniline]
Bis(chloromethyl)ether	$\alpha$ -Naphthylamine
1,4-Butanediol dimethylsulfonate (myleran)	$\beta$ -Naphthylamine
Carbon tetrachloride	Nickel carbonyl
Chlorambucil	4-Nitrobiphenyl
<b>Chloroform</b>	<i>N</i> -Nitrosodimethylamine
Chloromethyl methyl ether	$\beta$ -Propiolactone
Chromium & certain chromium compounds	<b>Styrene</b>
Cyclophosphamide	Thioacetamide
1,2-Dibromo-3-chloropropane	Thorium dioxide
3,3'-Dichlorobenzidine (and its salts)	Treosulfan
Diethylstilbestrol	<b>Vinyl chloride</b>
4-Dimethylaminoazobenzene	

Chemicals that fall under the classification of “Reproductive Toxins” will be identified on the MSDS as:

- Reproductive toxin
- Mutagenic
- May cause genetic damage
- Mutagen

### Examples of Reproductive Toxins

Arsenic & certain arsenic compounds	Ethylene oxide
<b>Benzene</b>	Lead compounds
Cadmium & certain cadmium compounds	Mercury compounds
Carbon disulfide	<b>Toluene</b>
<b>Ethidium bromide</b>	Vinyl chloride
Ethylene glycol monomethyl & ethyl ethers	<b>Xylene</b>

Chemicals that fall under the classification of “Substances with a high degree of acute toxicity” will be identified on the MSDS as:

- Oral LD<sub>50</sub> less than 50 mg/kg for Rats
- Skin Contact LD<sub>50</sub> less than 200 mg/kg for Rabbits
- Inhalation LD<sub>50</sub> less than 200 ppm for 1h for Rats
- Inhalation LD<sub>50</sub> less than 2,000 mg/m<sup>3</sup> for 1h for Rats
- NFPA Health rating of 4
- NFPA Health rating of 3
- HMIS Health rating of 4
- HMIS Health rating of 3

### Examples of Compounds that display a high degree of acute toxicity

Acrolein	Nickel carbonyl
Arsine	Nitrogen dioxide
Chlorine	Osmium tetroxide
Diazomethane	Ozone
Diborane	Phosgene
Hydrogen cyanide	Sodium azide
Hydrogen fluoride	Sodium cyanide
Methyl fluorosulfonate	

**Standard Operating Procedure for \_\_\_\_\_**

Principle Investigator: \_\_\_\_\_ Building: \_\_\_\_\_ Room: \_\_\_\_\_

For applications using \_\_\_\_\_, the material must be handled according to BGSU's General Standard Operating Procedures and these additional procedures:

**Process**

**Personal Protective Equipment**

**Designated Area for Use and Containment Devices**

- All \_\_\_\_\_ work shall be done in the laboratory fume hood. The fume hood's sash must be in the position where a face velocity of 100 feet per minute is achieved. Use laboratory fume hood \_\_\_\_\_.

**Special Handling Procedures and Storage Requirements**

**Decontamination of Equipment and Area**

**Removal of Waste**

- Excess \_\_\_\_\_ and all waste material containing this compound must be placed in a glass container labeled with the chemical's name of "\_\_\_\_\_" Full containers of waste must be manifested and disposed of according to BGSU's Hazardous Waste Program.

**Spill and Accident Procedures**

- In the event of a spill, immediately vacate and secure the area. Contact Environmental Health & Safety at 2-2171 and \_\_\_\_\_ (the immediate supervisor).

## ----- Example Only-----Standard Operating Procedure for Acrylamide

Principle Investigator: \_\_\_\_\_ Building: \_\_\_\_\_ Room: \_\_\_\_\_

For applications using acrylamide, the material must be handled according to BGSU's General Standard Operating Procedures and these additional procedures:

### Major Hazard

- Suspected human carcinogen (OSHA "select carcinogen") and neurotoxin.
- Can be absorbed through the skin and is a major route of exposure.

### Process

- Use of Acrylamide in powder/dry form for making electrophoresis gels.
- Any operation capable of generating acrylamide dust or aerosols of solutions.

### Personal Protective Equipment

- Protective gloves must be used at all times when handling the material. Use rubber nitrile gloves.
- Glove use must follow the recommendations established by the manufacturer. After removing the gloves, wash hands with soap and water.
- Safety goggles must be worn at all times to prevent eye contact.

### Designated Area for Use and Containment Devices

All acrylamide work shall be done in the laboratory fume hood. The fume hood's sash must be in the position where a face velocity of 100 feet per minute is achieved. Use laboratory fume hood \_\_\_\_\_.

### Special Handling Procedures and Storage Requirements

- Powder easily becomes airborne and may result in personal exposure and area contamination. Use care to avoid dispersing dust. Keep container tightly closed to prevent acrylamide from subliming and entering the atmosphere. Store in a cool place. Keep from contact with oxidizing materials, reducing agents, acids, bases, metal and contaminants.
- Protect vacuum pumps against contamination by using scrubbers or HEPA filters and then vent them into the hood. Decontaminate vacuum pumps in the hood before removing them from the controlled area.

### Decontamination of Equipment and Area

- Periodically treat area where unpolymerized acrylamide is used with 1.6% potassium persulfate, then with 1.6 % sodium metabisulfite. Let stand for 30 minutes, then wash with plenty of water.

### Removal of Waste

Excess acrylamide and all waste material containing acrylamide must be placed in a glass container labeled with the following "ACRYLAMIDE WASTE." Full containers of waste must be manifested and disposed of according to BGSU's Hazardous Waste Program.

### Spill and Accident Procedures

In the event of a spill, immediately vacate and secure the area. Contact Environmental Health & Safety at 372-2171 and \_\_\_\_\_ (the immediate supervisor).

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## Safety Data Sheets

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### The Safety Data Sheet

#### 1) Identification

This section identifies the chemical on the SDS as well as the recommended uses. It also provides the essential contact information of the supplier. The required information consists of:

- Product identifier used on the label and any other common names or synonyms by which the substance is known.
- Name, address, phone number of the manufacturer, importer, or other responsible party, and emergency phone number.
- Recommended use of the chemical (e.g., a brief description of what it actually does, such as flame retardant) and any restrictions on use (including recommendations given by the supplier).

#### 2) Hazard(s) Identification

This section identifies the hazards of the chemical presented on the SDS and the appropriate warning information associated with those hazards. The required information consists of:

- The hazard classification of the chemical (e.g., flammable liquid, category).
- Signal word.
- Hazard statement(s).
- Pictograms (the pictograms or hazard symbols may be presented as graphical reproductions of the symbols in black and white or be a description of the name of the symbol (e.g., skull and crossbones, flame).
- Precautionary statement(s).
- Description of any hazards not otherwise classified.
- For a mixture that contains an ingredient(s) with unknown toxicity, a statement describing how much (percentage) of the mixture consists of ingredient(s) with unknown acute toxicity. Please note that this is a total percentage of the mixture and not tied to the individual ingredient(s).

#### 3) Composition/Information on Ingredients

This section identifies the ingredient(s) contained in the product indicated on the SDS, including impurities and stabilizing additives. This section includes information on substances, mixtures, and all chemicals where a trade secret is claimed. The required information consists of:

##### **Substances**

- Chemical name.
- Common name and synonyms.
- Chemical Abstracts Service (CAS) number and other unique identifiers.
- Impurities and stabilizing additives, which are themselves classified and which contribute to the classification of the chemical.

### **Mixtures**

- Same information required for substances.
- The chemical name and concentration (i.e., exact percentage) of all ingredients which are classified as health hazards and are:
  - Present above their cut-off/concentration limits or
  - Present a health risk below the cut-off/concentration limits.
- The concentration (exact percentages) of each ingredient must be specified except concentration ranges may be used in the following situations:
  - A trade secret claim is made,
  - There is batch-to-batch variation, or
  - The SDS is used for a group of substantially similar mixtures.

### **Chemicals where a trade secret is claimed**

- A statement that the specific chemical identity and/or exact percentage (concentration) of composition has been withheld as a trade secret is required.

#### 4) First-Aid Measures

This section describes the initial care that should be given by untrained responders to an individual who has been exposed to the chemical. The required information consists of:

- Necessary first-aid instructions by relevant routes of exposure (inhalation, skin and eye contact, and ingestion).
- Description of the most important symptoms or effects, and any symptoms that are acute or delayed.
- Recommendations for immediate medical care and special treatment needed, when necessary.

#### 5) Fire-Fighting Measures

This section provides recommendations for fighting a fire caused by the chemical. The required information consists of:

- Recommendations of suitable extinguishing equipment, and information about extinguishing equipment that is not appropriate for a particular situation.
- Advice on specific hazards that develop from the chemical during the fire, such as any hazardous combustion products created when the chemical burns.
- Recommendations on special protective equipment or precautions for firefighters.

#### 6) Accidental Release Measures

This section provides recommendations on the appropriate response to spills, leaks, or releases, including containment and cleanup practices to prevent or minimize exposure to people, properties, or the environment. It may also include recommendations distinguishing between responses for large and small spills where the spill volume has a significant impact on the hazard. The required information may consist of recommendations for:

- Use of personal precautions (such as removal of ignition sources or providing sufficient ventilation) and protective equipment to prevent the contamination of skin, eyes, and clothing.

- Emergency procedures, including instructions for evacuations, consulting experts when needed, and appropriate protective clothing.
- Methods and materials used for containment (e.g., covering the drains and capping procedures).
- Cleanup procedures (e.g., appropriate techniques for neutralization, decontamination, cleaning or vacuuming; adsorbent materials; and/or equipment required for containment/clean up)

#### 7) Handling and Storage

This section provides guidance on the safe handling practices and conditions for safe storage of chemicals. The required information consists of:

- Precautions for safe handling, including recommendations for handling incompatible chemicals, minimizing the release of the chemical into the environment, and providing advice on general hygiene practices (e.g., eating, drinking, and smoking in work areas is prohibited).
- Recommendations on the conditions for safe storage, including any incompatibilities. Provide advice on specific storage requirements (e.g., ventilation requirements)

#### 8) Exposure Controls/Personal Protection

This section indicates the exposure limits, engineering controls, and personal protective measures that can be used to minimize worker exposure. The required information consists of:

- OSHA Permissible Exposure Limits (PELs), American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Values (TLVs), and any other exposure limit used or recommended by the chemical manufacturer, importer, or employer preparing the safety data sheet, where available.
- Appropriate engineering controls (e.g., use local exhaust ventilation, or use only in an enclosed system).
- Recommendations for personal protective measures to prevent illness or injury from exposure to chemicals, such as personal protective equipment (PPE) (e.g., appropriate types of eye, face, skin or respiratory protection needed based on hazards and potential exposure).
- Any special requirements for PPE, protective clothing or respirators (e.g., type of glove material, such as PVC or nitrile rubber gloves; and breakthrough time of the glove material).

#### 9) Physical and Chemical Properties

This section identifies physical and chemical properties associated with the substance or mixture. The minimum required information consists of:

- Appearance (physical state, color, etc.);
- Upper/lower flammability or explosive limits;
- Odor;
- Vapor pressure;
- Odor threshold;
- Vapor density;
- pH;
- Relative density;

- Melting point/freezing point;
- Solubility(ies);
- Initial boiling point and boiling range;
- Flash point;
- Evaporation rate;
- Flammability (solid, gas);
- Partition coefficient: n-octanol/water;
- Auto-ignition temperature;
- Decomposition temperature; and
- Viscosity.

The SDS may not contain every item on the above list because information may not be relevant or is not available. When this occurs, a notation to that effect must be made for that chemical property. Manufacturers may also add other relevant properties, such as the dust deflagration index (Kst) for combustible dust, used to evaluate a dust's explosive potential

#### 10) Stability and Reactivity

This section describes the reactivity hazards of the chemical and the chemical stability information. This section is broken into three parts: reactivity, chemical stability, and other. The required information consists of:

##### **Reactivity**

- Description of the specific test data for the chemical(s). This data can be for a class or family of the chemical if such data adequately represent the anticipated hazard of the chemical(s), where available.

##### **Chemical stability**

- Indication of whether the chemical is stable or unstable under normal ambient temperature and conditions while in storage and being handled.
- Description of any stabilizers that may be needed to maintain chemical stability.
- Indication of any safety issues that may arise should the product change in physical appearance.

##### **Other**

- Indication of the possibility of hazardous reactions, including a statement whether the chemical will react or polymerize, which could release excess pressure or heat, or create other hazardous conditions. Also, a description of the conditions under which hazardous reactions may occur.
- List of all conditions that should be avoided (e.g., static discharge, shock, vibrations, or environmental conditions that may lead to hazardous conditions).
- List of all classes of incompatible materials (e.g., classes of chemicals or specific substances) with which the chemical could react to produce a hazardous situation.
- List of any known or anticipated hazardous decomposition products that could be produced because of use, storage, or heating. (Hazardous combustion products should also be included in the Fire-Fighting Measures of the SDS.)

### 11) Toxicological Information

This section identifies toxicological and health effects information or indicates that such data are not available. The required information consists of:

- Information on the likely routes of exposure (inhalation, ingestion, skin and eye contact). The SDS should indicate if the information is unknown.
- Description of the delayed, immediate, or chronic effects from short- and long-term exposure.
- The numerical measures of toxicity (e.g., acute toxicity estimates such as the LD50 (median lethal dose)) - the estimated amount [of a substance] expected to kill 50% of test animals in a single dose.
- Description of the symptoms. This description includes the symptoms associated with exposure to the chemical including symptoms from the lowest to the most severe exposure.
- Indication of whether the chemical is listed in the National Toxicology Program (NTP) Report on Carcinogens (latest edition) or has been found to be a potential carcinogen in the International Agency for Research on Cancer (IARC) Monographs (latest editions) or found to be a potential carcinogen by OSHA

### 12) Ecological Information (non-mandatory)

This section provides information to evaluate the environmental impact of the chemical(s) if it were released to the environment. The information may include:

- Data from toxicity tests performed on aquatic and/or terrestrial organisms, where available (e.g., acute or chronic aquatic toxicity data for fish, algae, crustaceans, and other plants; toxicity data on birds, bees, plants).
- Whether there is a potential for the chemical to persist and degrade in the environment either through biodegradation or other processes, such as oxidation or hydrolysis.
- Results of tests of bioaccumulation potential, making reference to the octanol-water partition coefficient ( $K_{ow}$ ) and the bioconcentration factor (BCF), where available.
- The potential for a substance to move from the soil to the groundwater (indicate results from adsorption studies or leaching studies).
- Other adverse effects (e.g., environmental fate, ozone layer depletion potential, photochemical ozone creation potential, endocrine disrupting potential, and/or global warming potential).

### 13) Disposal Considerations (non-mandatory)

This section provides guidance on proper disposal practices, recycling or reclamation of the chemical(s) or its container, and safe handling practices. To minimize exposure, this section should also refer the reader to Section 8 (Exposure Controls/Personal Protection) of the SDS. The information may include:

- Description of appropriate disposal containers to use.
- Recommendations of appropriate disposal methods to employ.
- Description of the physical and chemical properties that may affect disposal activities.
- Language discouraging sewage disposal.
- Any special precautions for landfills or incineration activities

#### 14) Transportation Information (non-mandatory)

This section provides guidance on classification information for shipping and transporting of hazardous chemical(s) by road, air, rail, or sea. The information may include:

- UN number (i.e., four-figure identification number of the substance)<sup>1</sup>.
- UN proper shipping name<sup>1</sup>.
- Transport hazard class(es)<sup>1</sup>.
- Packing group number, if applicable, based on the degree of hazard<sup>2</sup>.
- Environmental hazards (e.g., identify if it is a marine pollutant according to the International Maritime Dangerous Goods Code (IMDG Code)).
- Guidance on transport in bulk (according to Annex II of MARPOL 73/78<sup>3</sup> and the International Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk (International Bulk Chemical Code (IBC Code))).
- Any special precautions which an employee should be aware of or needs to comply with, in connection with transport or conveyance either within or outside their premises (indicate when information is not available).

#### 15) Regulatory Information (non-mandatory)

This section identifies the safety, health, and environmental regulations specific for the product that is not indicated anywhere else on the SDS. The information may include:

- Any national and/or regional regulatory information of the chemical or mixtures (including any OSHA, Department of Transportation, Environmental Protection Agency, or Consumer Product Safety Commission regulations)

#### 16) Other Information

This section indicates when the SDS was prepared or when the last known revision was made. The SDS may also state where the changes have been made to the previous version. You may wish to contact the supplier for an explanation of the changes. Other useful information also may be included here.

### **Obtaining Safety Data Sheets On-Line**

The websites can only be accessed on campus:

<https://jr.chemwatch.net/chemwatch.web/home> (GoldFFX)

<http://www.bgsu.edu/content/dam/BGSU/envhs/documents/Hazard%20Communication/ChemWatch-Training.pdf> (GoldFFX User Guide)

Safety data sheets for chemicals are available through the chemical manufactures website.

**Personal Protective Equipment**

<b>Hazardous Material Handled in the Laboratory</b>	<b>Personal Protective Equipment Required and Recommended</b>
<p><b>Acids</b> Small containers &lt; 1 liter</p> <p>Large containers &gt; 1 liter</p>	<p>Safety goggles, appropriate gloves, closed toe shoes required. Long sleeved lab coat recommended.</p> <p>Safety goggles, appropriate gloves, closed toe shoes, and a rubber apron required. If a potential for a splash is high, it is advised to use both a face shield and goggles.</p>
<p><b>Caustic Liquids</b> Small containers &lt; 1 liter</p> <p>Large containers &gt; 1 liter</p>	<p>Safety goggles, appropriate gloves, closed toe shoes required. Long sleeved lab coat recommended.</p> <p>Safety goggles, appropriate gloves, closed toe shoes, and a rubber apron required. If a potential for a splash is high, it is advised to use both face shield and goggles.</p>
<p><b>Flammable liquids</b></p> <p>Dispensing form 5 gal containers</p>	<p>Safety goggles, appropriate gloves, closed toe shoes required. Long sleeved lab coat recommended.</p> <p>Safety goggles, appropriate gloves, closed toe shoes required. Long sleeve lab coat recommended. If the potential for a splash is high, it is advisable to use a face shield in addition to goggles.</p>
<p><b>Highly reactive liquid chemicals and high energy oxidizers</b></p>	<p>Safety goggles, appropriate gloves, closed toe shoes required. Long sleeve lab coat recommended. Face shield or body shield must be used in addition to protective eyewear during the reaction based on the scale of the reaction.</p>
<p><b>Liquids with high acute toxicity (poisons)</b></p>	<p>Safety goggles, appropriate gloves, appropriate impermeable apron, closed toe shoes. Long sleeve lab coat recommended. If the potential for a splash is high, use impermeable coveralls and a face shield in addition to goggles.</p>
<p><b>Liquids with high chronic toxicity (carcinogens and reproductive toxins)</b></p>	<p>Safety goggles, appropriate gloves, closed toe shoes required. Long sleeve lab coat recommended.</p>
<p><b>Other hazardous liquid chemicals (not included in the above categories)</b></p>	<p>Safety goggles, appropriate gloves, closed toe shoes required. Long sleeve lab coat recommended.</p>

<b>Hazardous Material Handled in the Laboratory</b>	<b>Personal Protective Equipment Required and Recommended</b>
<b>Caustic solids</b> (lime, etc)	Safety goggles, appropriate gloves, closed toe shoes required. Long sleeve lab coat recommended. If the potential for a splash is high, it is advisable to use a face shield in addition to goggles.
<b>Flammable solids</b> (alkali metals, red phosphorous, etc)	Safety goggles, appropriate gloves, closed toe shoes required. Long sleeve lab coat recommended.
<b>Highly reactive solids &amp; high energy oxidizers</b>	Safety goggles, appropriate gloves, closed toe shoes required. Long sleeve lab coat recommended. Face shield or body shield should be worn during reactions based on the scale of the reaction in addition to protective eyewear.
<b>Solids of high acute toxicity</b> (poisons)	Safety goggles, appropriate gloves, closed toe shoes required. Long sleeve lab coat recommended. If work is done on an open bench and the potential for disseminating powder is high, appropriate respiratory protection must be used.
<b>Solids of high chronic toxicity</b> (carcinogens and reproductive toxins)	Safety goggles, appropriate gloves, closed toe shoes required. Long sleeve lab coat recommended. If work is done on an open bench and the potential for disseminating powder is high, appropriate respiratory protection must be used.
<b>Other hazardous solid chemicals</b> (not included in the above categories)	Safety goggles, appropriate gloves, closed toe shoes required. Long sleeve lab coat recommended.
<b>Compressed toxic gas</b>	Safety goggles, appropriate gloves, closed toe shoes required. Long sleeve lab coats recommended.
<b>Work with pressurized glass/plastic vessels</b> (potential for creating flying fragments)	Face shield, safety goggles, appropriate gloves, closed toe shoes required. Long sleeve lab coat recommended.

<b>Hazardous Material Handled in the Laboratory</b>	<b>Personal Protective Equipment Required and Recommended</b>
<p><b>Light Radiation</b></p> <p>Class IIIb Lasers</p> <p>Class IV Lasers</p> <p>Sources of UV light</p>	<p>Protective eyewear of the appropriate optical density.</p> <p>Protective eyewear of the appropriate optical density.</p> <p>Appropriate protective eyewear and appropriate gloves required. Long sleeve lab coat recommended. Based on the duration of exposure and the source, it is advisable to use a face shield instead of goggles.</p>
<p><b>Temperature extremes</b></p> <p>Heat (hot surfaces, hot solutions, etc)</p> <p>Cold (cold rooms)</p> <p>Cryogenic gases (N<sub>2</sub>, He<sub>2</sub>, etc)</p>	<p>Face shield, appropriate thermal gloves, closed toe shoes required. Long sleeve lab coat recommended.</p> <p>Appropriate thermal gloves, closed toe shoes required. Long sleeve lab coat recommended.</p> <p>Face shield, appropriate thermal gloves, closed toe shoes required. Long sleeve lab coat recommended.</p>
<p><b>Autoclave operation</b></p>	<p>Face shield, rubber apron, appropriate thermal gloves, closed toe shoes required. Long sleeve lab coat recommended.</p>

The above table has been adapted from Yale University's Chemical Hygiene Plan.

## Appropriate glove selection

Selecting the appropriate type of glove to use with the chemicals you are working with is critical in preventing skin exposure to many corrosive and toxic chemicals. (See section 4 of this manual or refer to the glove manufacturer you will be purchasing from.)

Chemicals can pass through gloves by three major methods. They can permeate or diffuse through gloves at the molecular level. Chemicals can interact with the glove material and degrade or change the physical properties of the glove, which allows the chemical to pass through the glove. For example, latex gloves are readily soluble in toluene and hexane. Finally, chemicals can penetrate the glove through imperfections in the glove material such as small tears, rips, pinholes, and other damage, which allows chemicals to pass through the glove. Therefore, no one glove exists that can provide protection against all chemicals.

Many chemicals are easily absorbed through the skin and skin absorption is a major contributor to an individual's total exposure to a chemical. The chemicals listed below are examples of substances that have the potential to contribute significantly to an individual's exposure by skin contact.

Acetonitrile	Carbon tetrachloride	Mercury – alkyl compounds
Acrylamide	Catechol	Mercury – aryl compounds
Acrylonitrile	Cresol	Mercury – elemental
Aniline	Cyclohexanol	Methanol
Benzene	Cyclohexanone	Methyl n-butyl ketone
Benzidine	1,4 Dioxane	Naphthalene
Bromoform	n-Hexane	Phenol
Carbon disulfide	Hydrogen cyanide & salts	Toluene

Therefore, selection and use of a glove or gloves for chemicals you work with is extremely important. Use the following criteria to assist in selecting the appropriate glove.

1. Know the toxic properties of the chemicals you are working with. In particular, the chemicals' ability to cause local effects on the skin and/or to pass through the skin and be spread throughout the body, affecting all body systems and organs.
2. Generally, any "chemical resistant" glove can be used for dry powders.
3. For mixtures and formulated products (unless specific test data are available), a glove should be selected on the basis of the chemical component with the shortest breakthrough time, since it is possible for solvents to carry active ingredients through polymeric materials.
4. The gloves must be removed in such a manner as to prevent skin contamination.

## Eye and Face Protection

Eye and face protection should be selected in accordance with the Standard Laboratory Procedures in the BGSU Chemical Hygiene Plan.

Chemical splash goggles (figure 22) are preferred over safety glasses (figure 23) for eye protection in the laboratory. Chemical splash goggles are recommended for all laboratory activities using chemicals. Ventilated chemical splash goggles may be used so long as the indirect vents and the goggle protect the wearer from splash entry.



Figure 22  
Chemical Splash Goggles



Figure 23  
Safety Glasses

When a significant splash or explosion hazard exists, the use of a face shield (figure 24) is required in addition to chemical splash goggles. The face shield must cover the entire face.

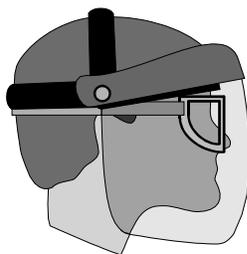


Figure 24  
Splash goggles and Face Shield

## Respiratory Protection

The use of respirators is prohibited by University policy unless its use is permitted by Environmental Health and Safety (2-2171).



Figure 25 - Respirator

## Chemical Waste Disposal

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### Drain Disposal

With appropriate dilution (100 times the volume), there are certain organic and inorganic compounds that can be properly disposed of in the sanitary sewer system in quantities of approximately 100 grams at a time. As a general rule, water-soluble organic compounds with a boiling point  $<50^{\circ}\text{C}$  should not be disposed of in the sanitary sewer system. The compounds identified below are water soluble to at least 3% and present a low toxicity hazard. The organic compounds listed on the following pages are readily biodegradable. Some chemicals suitable for drain disposal are:

#### Organic Chemicals

##### Alcohols

Alkanols with less than 5 carbon atoms

t-Amyl alcohol

Alkanediols with less than 8 carbon atoms

Glycerol

Sugars and sugar alcohols

Alkoxyalkanols with less than 7 carbon atoms

n-C<sub>4</sub>H<sub>9</sub>OCH<sub>2</sub>CH<sub>2</sub>OCH<sub>2</sub>CH<sub>2</sub>OH

2-Chloroethanol

##### Aldehydes

Aliphatic aldehydes with less than 5 carbon atoms

##### Amides

RCONH<sub>2</sub> and RCONHR with less than 5 carbon atoms

RCONR<sub>2</sub> with less than 11 carbon atoms

##### Amines

Aliphatic amines with less than 7 carbon atoms

Aliphatic diamines with less than 7 carbon atoms

Benzylamine

Pyridine

##### Carboxylic Acids

Alkanoic acids with less than 6 carbon atoms \*

Alkanedioic acids with less than 6 carbon atoms

Hydroxyalkanoic acids with less than 6 carbon atoms

Aminoalkanoic acids with less than 7 carbon atoms

Ammonium, sodium, and potassium salts of the above acid classes with less than 21 carbon atoms

Chloroalkanoic acids with less than 4 carbon atoms

Esters

Esters with less than 5 carbon atoms

Isopropyl acetate

Those with disagreeable odor (i.e. dimethylamine, 1,4-butanediamine, butyric and valeric acids) should be neutralized and the resulting salts disposed of in a sanitary sewer drain after being diluted with water at least 1000 times the volume.

Ketones

Ketones with less than 6 carbon atoms

Nitriles

Acetonitrile

Propionitrile

Sulfonic Acids

Sodium or potassium salts of most are acceptable

Inorganic Compounds

Compounds of any ions listed below which are strongly acidic or basic should be neutralized before being disposed of in a sanitary sewer drain.

<b>Cations</b>	<b>Anions</b>
Al <sup>3+</sup>	BO <sub>3</sub> <sup>3-</sup> , B <sub>4</sub> O <sub>7</sub> <sup>2-</sup>
Ca <sup>2+</sup>	Br <sup>-</sup>
Fe <sup>2+, 3+</sup>	CO <sub>3</sub> <sup>2-</sup>
H <sup>+</sup>	HSO <sub>3</sub> <sup>-</sup>
K <sup>+</sup>	OCN <sup>-</sup>
Li <sup>+</sup>	OH <sup>-</sup>
Mg <sup>2+</sup>	I <sup>-</sup>
Na <sup>+</sup>	NO <sub>3</sub> <sup>-</sup>
NH <sub>4</sub> <sup>+</sup>	PO <sub>4</sub> <sup>3-</sup>
Sn <sup>2+</sup>	SO <sub>4</sub> <sup>2-</sup>
Sr <sup>2+</sup>	SCN <sup>-</sup>
Ti <sup>3+, 4+</sup>	
Zn <sup>2+</sup>	
Zr <sup>2+</sup>	

## Chemical Waste Collection

All containers used for the collection/storage of hazardous wastes must be structurally sound. The utilization of proper containers minimizes the potential for leakage and/or other releases into the environment. Whenever possible, the original container(s) need to be used. Container determination should be based on chemical characteristics of the waste material to be stored. For example, corrosive wastes should not be placed in a metal container.

Collection sites need to be established within the laboratory or other areas where hazardous wastes are generated. Waste containers should be conveniently located at these points as well. Individuals moving wastes to temporary storage sites must be knowledgeable of the relevant waste characteristics, waste handling guidelines, and appropriate spill control measures. Safety/spill control materials should also be readily available should a spill occur during transfer (see Spill Control Contingency Plan section).

**NOTE:** Safety cans and other similar storage containers are available through various commercial outlets. Recycled containers for waste storage may also be used. Information on acceptable chemical containers can be obtained through the Hazardous Waste Coordinator.

## Chemical Waste Labeling

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Containers with missing or illegible labels are classified as “unknowns.” Unknown chemicals that require disposal place an unnecessary and costly burden on the University. Testing of the chemical must be performed in order to determine the appropriate hazard category of the unknown waste. Therefore, all containers holding hazardous wastes must be properly labeled. Any container with a label that is not secure or is becoming illegible must be relabeled.

Containers containing chemical waste must be labeled according to these specifications:

- Waste chemicals that are in their original containers require only the words “hazardous waste” above the chemical name.
- All containers used for commingling of wastes must be labeled with the words “hazardous waste” and an identification of the contents. A preprinted label acceptable to the Hazardous Waste Coordinator is recommended.
- Additional labels may be needed if numerous compatible wastes are placed into one container.

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